**Brownian Dynamics Simulation and Diffusion Analysis**

**Objective:**

Simulate Brownian motion of particles using stochastic updates and analyze their mean square displacement (MSD) and diffusion characteristics.

**Methodology:**

* Used non-dimensionalized rule:



* Simulated one particle over t∗=100 with Δt∗=0.001
* Computed MSD for t∗≤10
* Estimated diffusivity 
* Simulated 100 particles for t∗=50 and tracked distance from origin at multiple time points

**Results:**

1. **MSD vs t**\* (see msd\_single\_particle.png):
   * Showed a nearly linear rise in early times, confirming diffusive behavior.
2. **Estimated Diffusivity:** ****
3. **Average Distance vs t**\* (see avg\_distance\_vs\_time.png):
   * Grew as sqrt{t\*}​, consistent with diffusion theory.

**Conclusion:**

The simulation reproduces classical Brownian motion behaviour. MSD grows linearly with time, and average particle displacement scales with sqrt{t}​. The random walk nature of diffusion was confirmed both analytically and visually.

